WEST

AL

Generate Collection

L1: Entry 13 of 65 File: JPAB Sep 3, 1993

PUB-NO: JP405226704A
DOCUMENT-IDENTIFIER: JP 05226704 A
TITLE: THERMOELECTRIC DEVICE AND ITS MANUFACTURE

PUBN-DATE: September 3, 1993

INVENTOR-INFORMATION:

NAME	COUNTRY
NISHIWAKI, FUMITOSHI	
NAKAGIRI, YASUSHI	
YAMAMOTO, YOSHIAKI	
GYOTEN, HISAAKI	

ASSIGNEE-INFORMATION:

NAME	COUNTRY
MATSUSHITA ELECTRIC IND CO LTD	

APPL-NO: JP04023503
APPL-DATE: February 10, 1992

INT-CL (IPC): H01L 35/32; H01L 35/34

ABSTRACT:

PURPOSE: To provide a small, light, and inexpensive thermoelectric device high in thermoelectric conversion efficiency and its manufacture.

CONSTITUTION: At least a pair of projections 9 are provided at one side of one insulating plate 11, and a patterned electrode film 12 is provided between a pair of projections 9, and a p-type thermoelectric semiconductor film 13, on the electrode film 12 at one top of the projections 9 in a pair, and an n-type thermoelectric semiconductor film 14, on the electrode film 12 on the other top, are provided, and counter electrodes 15, which form a pair, are provided on the p-type thermoelectric semiconductor film 13 and the n-type thermoelectric semiconductor 14, and a pair of lead electrode films 16 are provided for the counter electrode films 15, and a pair of lead electrodes 16 are provided on one side of the other insulating plate 19.

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開平5－226704
(43)公開日　平成５年(1993)９月３日

(51)Int.Cl.[5]		識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｈ０１Ｌ	35/32	Ｚ	9276－4M		
	35/34		9276－4M		

審査請求　未請求　請求項の数６(全　９　頁)

(21)出願番号　特願平4－23503

(22)出願日　平成４年(1992)２月10日

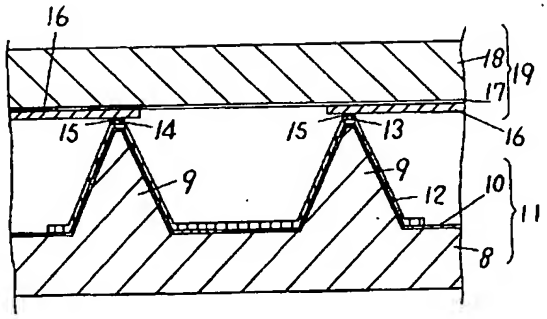
(71)出願人　000005821
松下電器産業株式会社
大阪府門真市大字門真1006番地
(72)発明者　西脇　文俊
大阪府門真市大字門真1006番地　松下電器産業株式会社内
(72)発明者　中桐　康司
大阪府門真市大字門真1006番地　松下電器産業株式会社内
(72)発明者　山本　義明
大阪府門真市大字門真1006番地　松下電器産業株式会社内
(74)代理人　弁理士　小鍜治　明　（外２名）

最終頁に続く

(54)【発明の名称】　熱電装置およびその製造方法

(57)【要約】
【目的】　熱電変換効率が高く、小型・軽量で安価な熱電装置およびその製造方法の提供を目的とする。
【構成】　一方の絶縁板１１の一面に少なくとも１対の突起９を設け、１対の突起９間にパターニングされた電極膜１２を設け、１対の突起９の一方の頂部の電極膜１２上にＰ型熱電半導体膜１３、他方の頂部の電極膜１２上にＮ型熱電半導体膜１４を設け、Ｐ型熱電半導体膜１３およびＮ型熱電半導体１４上に１対となる対向電極膜１５を設け、対向電極膜１５に接して１対の取り出し電極膜１６を設け、１対の取り出し電極１６が他方の絶縁板１９の一面に設けられている。

9　突起
11,19　絶縁板
12　電極膜
13　Ｐ型熱電半導体膜
14　Ｎ型熱電半導体膜
15　対向電極膜
16　取り出し電極膜



1

【特許請求の範囲】

【請求項1】　一方の絶縁板の一面に少なくとも1対の突起を設け、その1対の突起間にパターニングされた電極膜を設け、上記1対の突起の一方の頂部の電極膜上にP型熱電半導体膜、他方の頂部の電極膜上にN型熱電半導体膜を設け、そのP型熱電半導体膜およびN型熱電半導体膜上に1対となる対向電極膜を設け、その対向電極膜に接してパターニングされた1対の取り出し電極膜を設け、その1対の取り出し電極膜が他方の絶縁板の一面に設けられている熱電装置。

【請求項2】　一方の絶縁板上にパターニングされた電極膜を設け、その電極膜上に少なくとも1対の電極部を設け、前記1対の電極部の一方の頂部にP型熱電半導体膜、他方の頂部にN型熱電半導体膜を設け、そのP型熱電半導体膜およびN型熱電半導体膜上に1対となる対向電極膜を設け、その対向電極膜に接してパターニングされた1対の取り出し電極膜を設け、その1対の取り出し電極膜が他方の絶縁板の一面に設けられている熱電装置。

【請求項3】　請求項1または2記載の熱電装置を2層以上積層した熱電装置。

【請求項4】　請求項1，2または3記載の熱電装置の一方の絶縁板の他面に熱的に接触した熱交換手段を設けた熱電装置。

【請求項5】　一方の絶縁板の一面に少なくとも1対の突起を形成する工程と、上記一面上にパターニングされた電極膜を形成する工程と、上記1対の突起の一方の頂部の電極膜上にP型熱電半導体膜、他方の頂部の電極膜上にN型熱電半導体膜を形成する工程と、上記P型熱電半導体膜およびN型熱電半導体膜上に対向電極膜を形成する工程と、他方の絶縁板の一面上にパターニングされた取り出し電極膜を形成する工程と、上記一方の絶縁板の一面と上記他方の絶縁板の一面を電気的に接合させる工程とからなる熱電装置の製造方法。

【請求項6】　一方の絶縁板の一面にパターニングされた電極膜を形成する工程と、上記電極膜上に少なくとも1対の電極部を形成する工程と、前記1対の電極部の一方の頂部にP型熱電半導体膜、他方の頂部にN型熱電半導体膜を形成する工程と、上記P型熱電半導体膜およびN型熱電半導体膜上に対向電極膜を形成する工程と、他方の絶縁板の一面上にパターニングされた取り出し電極膜を形成する工程と、上記一方の絶縁板の一面と上記他方の絶縁板の一面を電気的に接合させる工程とからなる熱電装置の製造方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、ペルチェ効果により電気的に吸熱または放熱を行う冷却・加熱装置、またはゼーベック効果により温度差を利用して発電を行う発電装置などに用いる熱電装置およびその製造方法に関する。

2

【0002】

【従来の技術】従来の熱電装置は、図12に示すように、金属板1および2によってN型熱電半導体3およびP型熱電半導体4を挟み込み、それらを交互に電電気的に直列に、かつ熱的に並列に配列し、端子5と端子6間に電位を与えると、一方の金属板が冷却され、他方が加熱される。7は絶縁板である。（例えば、上村、西田著「熱電半導体とその応用」日刊工業新聞社（1988）p．39）このような熱電装置の製造方法は、以下のように行われている。

【0003】熱電半導体としてはBi－Te系化合物が主に用いられており、溶製，焼結などの製法を用いてP型およびN型のブロックが作製され、その熱電半導体のブロックをダイヤモンド・カッターなどを用いて所定のバルク形状に成形する。熱電半導体の形状は角柱状と円柱状が一般的である。その大きさは、角柱状で最も小さな場合でも、1．4㎜×1．4㎜×1．7㎜程度の大きさを有する。金属板には銅板が用いられる。そして、多数の金属板によって、P型熱電半導体4とN型熱電半導体3を交互に挟み込み、電気的に直列に接続し、かつ熱的に並列に接続した構成となるように、熱電半導体と金属板をBi－Sn系共晶合金などで直接半田付けして接合されていた。

【0004】冷却能力の拡大は、熱電半導体の設置個数を増加させることにより、また冷却部と発熱部の温度差の拡大は図12に示した装置を多段に積層することによって行われていた。

【0005】

【発明が解決しようとする課題】しかしながら、上記のような従来の熱電装置およびその製造方法では、下記の問題があった。

（1）溶製，焼結などの製法により作製したバルクの熱電半導体は、その性能を向上させることが困難であり、効率が低かった。

（2）熱電半導体は脆い材料であるため、所定のバルク形状（例えば、1．4㎜×1．4㎜×1．7㎜程度に成形する際に、角部が欠け易く、歩留まりが非常に低かった。

（3）上記のような非常に小さな大きさで、多数（約200個程度）の熱電半導体を大きさのばらつきなく、しかもP型とN型を交互に正確に配列することが困難であるため、歩留まりが非常に低かった。

（4）上記の製造上の課題のため、熱電半導体の大きさを小さくできず、そのため、熱電半導体の厚さが1㎜以下であるような薄い熱電装置を作製することは困難であった。

（5）製造工程が連続的でなく、個々の部品をそれぞれ作製して組み立てるため、大量に製造する場合、時間と手間がかかり製造コストを下げることが困難であった

（6）希少金属を大量に使用するため、材料コストが高

くなり、熱電装置の重量および容積が大きくなる。

（7）カスケード方式により積層し、低温と高温の温度差を大きくしようとすると、厚みが増加し、重量が増加していた。

【0006】本発明は、上記の問題を解決し、熱電変換効率が高く、小型・軽量で安価な熱電装置およびその製造方法の提供を目的とする。

【0007】

【課題を解決するための手段】上記の目的を達成するために本発明の熱電装置は、一方の絶縁板の一面に少なくとも1対の突起を設け、その1対の突起間にパターニングされた電極膜を設け、上記1対の突起の一方の頂部の電極膜上にP型熱電導体膜，他方の頂部の電極膜上にN型熱電半導体膜を設け、そのP型熱電半導体膜およびN型熱電半導体膜上に1対となる対向電極膜を設け、その対向電極膜に接してパターニングされた1対の取り出し電極膜を設け、その1対の取り出し電極膜が他方の絶縁板の一面に設けられている構成とする。

【0008】

【作用】上記の構成によれば、熱的非平衡状態のもとで作製した性能の高い熱電半導体膜と熱絶縁の良好な熱電装置が構成できることによる。

【0009】

【実施例】（実施例1）以下に本発明の第1の実施例を添付図面に基づいて説明する。

【0010】図1は本実施例の要部拡大縦断面図である。同図において、8はその表面に突起9を機械加工などの方法により作製した一方のアルミニウム基板である。1対の突起9は高さ1㎜、頂部口0．1㎜、底部口1㎜の四角錐であり、2．2㎜ピッチで形成されている。一方のアルミニウム基板8の一面には、電気絶縁膜として厚さ30μmのポリイミド樹脂フィルム10が設けられて一方の絶縁板11を形成している。さらに、その上面には、パターニングされた電極膜12（厚さ70μm）が設けられている。電極膜12は、隣合う1対の突起9の頂部同志を電気的に直列に接続し、他の突起の頂部に設けられた電極膜とは絶縁されるようにパターニングされている。1対の突起9の頂部の電極膜12上には、真空蒸着、溶射などの手法用いてマスキングしながらP型熱電半導体膜13とN型熱電半導体膜14を設け、そのP型熱電半導体膜13およびN型熱電半導体膜14上に1対となる対向電極膜15を設け、その対向電極膜15に接して1対の取り出し電極膜16を設け、その1対の取り出し電極膜16が厚さ30μmのポリイミド樹脂フィルムの絶縁膜17を介して他方のアルミニウム板18からなる他方の絶縁板19の一面に設けられている。

【0011】熱電半導体膜13および14の製膜の際には、その膜13と14を交互に電気的に直列になるようなマスクパターンを採用し、取り出し電極膜16は熱的に並列によるようにパターニングされている。

【0012】図2は本実施例の平面図でり、図1の熱電半導体膜を多数設け、取り出し電極膜16は最終的に引出し電極20および20′に接続されている。図3は図2のX－X′線に沿った縦断面図、図4は同じく要部拡大横断面図である。

【0013】以上のように構成された熱電装置において、引出し電極20，20′の間に直流電圧を印加すれば、P型熱電半導体膜13N型熱電半導体膜14，電極膜12および取り出し電極膜16の界面でペルチェ効果により吸熱もしくは発熱が生じる。その結果、熱電装置の上下絶縁板の一方で冷却、他方で加熱を行なうことができる。すなわち、電気と熱の直接変換が可能となる。

【0014】なお、この時絶縁板の一方は低温、他方は高温となり、両板間に温度差が生じるが、絶縁板11上に高さ1㎜の突起9を設け、絶縁板11と絶縁板19の間の距離を約1㎜としたことにより、高温側絶縁板から低温側絶縁板へその間に存在する空気を介した熱伝導による熱損失はほとんど無視できる。

【0015】以上のように本実施例によれば、熱電半導体を熱的非平衡状態のもとで作製した性能の高い薄膜とすることにより熱電装置の効率を従来に比べ著しく高くすることができる。

【0016】また、真空蒸着などの製膜プロセスを用いて、マスキングしながら電極膜上に熱電半導体を一括製膜できるため、微細な膜形状の熱電半導体膜を位置精度良く、しかも形状のばらつきが少なく形成することが可能となる。さらに、熱電半導体を高密度に実装するため、単位面積あたりの吸熱量を増加させることが可能となり、発熱密度の大きな装置の冷却にも熱電装置が使用できるようになる。

【0017】さらに、熱電材料を薄膜としたため、使用するBi，Teなどの希少金属の量が僅かとなり、材料コスト費ひいては熱電装置のコストを低減することができる。

【0018】以上、本実施例の熱電装置を冷却装置として用いた場合について説明してきたが、この構成を有する熱電装置はゼーベック効果を利用して熱を電気に変換する発電装置として利用できることは言うまでもない。

【0019】図5および図6により本実施例の熱電装置の製造方法を説明する。まず、図5（a）に示すように、2㎜厚さの一方のアルミニウム板18を機械加工して、1㎜厚さのアルミニウム板8上に高さ1㎜、頂部口0．1㎜、底部口1㎜の大きさの多数の四角錘の突起9を2．2㎜ピッチで形成する。

【0020】次に、（b）に示すように、厚さ70μmの銅箔21上にポリアミド樹脂溶液を塗布し、硬化させて、厚さ30μmのポリイミド樹脂フィルムの絶縁膜10を形成する。

【0021】次に、（c）に示すように、銅箔21をリ

ソグラフィ工法を用いて所定の形状にパターニングし、絶縁膜１０上に電極膜１２を形成する。

【００２２】次に、（ｄ）に示すように、（ａ）で作製した突起９を設けたアルミニウム板８を雄のプレス型とし、突起９に対応した雌のプレス型２２を用いて、電極膜１２を設けたポリイミド樹脂フィルムの絶縁膜１０をプレス加工する。その際、突起９を設けたアルミニウム板８の表面にエポキシ系の接着剤を塗布している。その結果、（ｅ）に示すような、アルミニウム板８上に電極膜１２を設けたポリイミド樹脂フィルムの絶縁膜１０を熱的に接合したものを形成することができる。なお、電極膜１２は、隣合う２つの突起の頂部同志を電気的に直列に接続し、他の突起の頂部に形成された電極膜とは絶縁されるようにパターニングされている。

【００２３】次に、図６（ａ）に示すように、突起９の頂部の電極膜１２上に真空蒸着、溶射などの手法を用いてマスキングしながらＰ型熱電半導体膜１３とはＮ型熱電半導体膜１４を製膜する。熱電半導体膜の形状は約縦１００μｍ×横１００μｍ×厚さ１０μｍである。熱電半導体膜は、Ｐ型熱電半導体膜１３とＮ型熱電半導体膜１４が交互になるように製膜している。

【００２４】次に、（ｂ）に示すように、熱電半導体膜上に銅薄膜の方向電極膜１５（約１μｍ厚さ）を同様の方法を用いて製膜する。

【００２５】次に、図５（ｂ）～（ｄ）で示したのと同様な方法により、他方のアルミニウム板１８の一方の表面にも、パターニングされた取り出し電極膜１６を形成したポリイミド樹脂フィルムの絶縁膜１７を熱的に接着し、図６（ｃ）に示す上部の基板を作製する。

【００２６】最後に、アルミニウム板１８の一方の面に形成した取り出し電極膜１６上に所定のパターンのクリーム半田層を印刷した後、取り出し電極膜１６と、Ｐ型熱電半導体膜１３およびＮ型熱電半導体膜１４上に形成した対向電極膜１５が接触するように組み合わせ、昇温して半田層を硬化して、電気的接合を確保している。このようにして、図６（ｄ）に示すように、製膜された全てのＰ型熱電半導体膜１３とＮ型熱電半導体膜１４が電気的に直列で、かつ熱的に並列であるような熱電装置を作製することができる。

【００２７】なお、本実施例では、銅箔２１上にポリアミド樹脂溶液を塗布し、硬化させて、ポリイミド樹脂フィルムの絶縁膜１０を形成することにより、銅箔２１とポリイミド樹脂フィルムの絶縁膜１０の積層物を作製したが、同様な構成を有する市販の銅張り積層板を用いても良い。

【００２８】以上のように、本実施例によれば、真空製膜プロセスを用いて、マスキングしながら電極膜上にＰ型熱電半導体膜およびＮ型熱電半導体膜を一括製膜できるため、所定の膜形状の熱電半導体を位置精度良く、しかも形状のばらつき少なく形成することが可能となる。その結果、熱電装置を歩留まり良く、低コストで大量に製造することが可能である。さらに、製造プロセスの大面積化が容易であり、連続プロセスで行うことができるため、量産性に優れ、製造コストを下げることが可能となる。また、真空製膜プロセスを用いるため、熱電半導体膜の結晶成長面を制御することが容易となり、熱電材料の性能を一層高めることができる。

【００２９】（実施例２）図７は本発明の第２の実施例の要部拡大縦断面図である。

【００３０】同図において、１対のアルミニウム板１８ａ，１８ｂは厚さ１㎜であり、その１対のアルミニウム板１８ａ，１８ｂの一面には、厚さ３０μｍのポリイミド樹脂フィルムの絶縁膜１０ａ，１０ｂが形成され、絶縁板１９ａ，１９ｂを構成している。そして一方の絶縁板１９ａの一方の面上にはパターニングされた電極膜２３が、他方の絶縁板１９ｂの一方の面上には同様にして取り出し電極膜２４（いずれも厚さ７０μｍ、幅１．４㎜、長さ３．６㎜）が形成されている。一方の絶縁板１９ａ上に形成した電極膜２３の上に間隔２．２㎜で少なくとも１対の突起状の銅製の電極部２５を設け、１対の電極部２５を電気的に接合している。この電極部２５は高さ１㎜、頂部０．１㎜角、底部１㎜角の四角錐である。この電極部２５上には、真空蒸着、溶射などの手法を用いてマスキングしながらＰ型熱電半導体膜２６およびＮ型熱電半導体膜２７を製膜し、さらにその上面には銅薄膜の対向電極膜２８を同様の方法を用いて製膜している。熱電半導体膜の製膜の際には、隣合う電極部２５において、Ｐ型熱電半導体膜２６とＮ型熱電半導体膜２７が交互になるようなマスクパターンを採用した。そして、Ｐ型熱電半導体膜２６およびＮ型熱電半導体膜２７上に設けられた銅薄膜の対向電極膜２８と、他方の絶縁板１９ｂの一面に設けられた取り出し電極膜２４が電気的に接合するように組み立てられている。なお、電極膜２３および取り出し電極２４は、製膜されたすべてのＰ型熱電半導体膜２６とＮ型熱電半導体膜２７が電気的に直列に、かつ熱的に並列になるようにパターニングされている。

【００３１】第１の実施例と異なる点は、熱電半導体膜をその上に形成する電極部２５を薄膜ではなく、銅製の四角錐ブロックとした点である。

【００３２】以上のように構成された熱電装置に電流を流せば、Ｐ型熱電半導体膜２６，Ｎ型熱電半導体膜２７，２５および銅薄膜の対向電極膜２８の界面でペルチェ効果により吸熱もしくは発熱が生じる。その結果、熱電装置の上下絶縁板の一方で冷却、他方で加熱を行なうことができる。すなわち、電気と熱の直接変換が可能となる。

【００３３】以上のように本実施例によれば、熱電半導体として、熱的非平衡状態のもとで作製した性能の高い熱電半導体を用いることにより、熱電装置の効率を従来

に比べ著しく高くすることが可能となる。

【００３４】また、電極部２５を四角錘の銅製とし、電流の流路断面積を増加させたため、電極部が薄膜である場合に比べ、電極部におけるジュール発熱による熱損失量を低減することができる。したがって、熱電装置の吸熱量を増加させることが可能となり、一層、熱電装置の効率を高くすることができる。

【００３５】また、第１の実施例と同様に、熱電半導体を高密度に実装することによる単位面積あたりの冷却能力の増加および使用する熱電材料の量が僅かとなることによるコストの低減を図ることができる。

【００３６】図７および図８により本実施例の熱電装置の製造方法を説明する。まず、図８（ａ）に示すように、厚さ７０μｍの銅箔２１上にポリアミド樹脂溶液を塗布し、硬化させて、厚さ３０μｍのポリイミド樹脂フィルムの絶縁膜１０ａを形成する。

【００３７】次に、（ｂ）に示すように、銅箔２１をリソグラフィ工法を用いて所定の形状にパターニングし、ポリイミド樹脂フィルムの絶縁膜１０ａ上に電極膜２３（厚さ７０μｍ、幅１．４㎜、長さ３．６㎜）を形成する。

【００３８】次に（ｃ）に示すように、アルミニウム板１８ａの面にエポキシ系の接着剤を塗布した後、電極膜２３を設けたポリイミド樹フィルムの絶縁膜１０ａを設置し、硬化させて、両者を熱的に接合して一方の絶縁板１９ａを製造する。

【００３９】次に、（ｄ）に示すように、電極膜２３の上に、間隔２．２㎜で少なくも１対の突起状の銅製の電極部２５を設置し、両者を電気的に接合する。電極部２５は高さ１㎜、頂部０．１㎜角、底部１㎜角の四角錘の銅ブロックであり、機械的に加工して作製している。そして、作製した四角錘の銅ブロックを所定の位置に四角錘の凹部を形成した雌型（図示せず）上で配置させた後、一括して電極膜２３の上に配置させる。なお、電極膜２３上には予めクリーム半田を塗布している。その後、昇温して、電極膜２３と四角錘の銅製の電極部２５を電気的に接合する。

【００４０】次に、（ｅ）に示すように、四角錘の電極部２５の頂部には、真空蒸着，溶射などのに手法を用いてマスキングしながらＰ型熱電半導体膜２６およびＮ型熱電半導体膜２７を製膜する。熱電半導体膜２６および２７の形状は約縦１００μｍ×横１００μｍ×厚さ１０μｍである。熱電半導体膜は、Ｐ型熱電半導体膜２６とＮ型熱電半導体膜２７が交互になるように製膜している。

【００４１】さらに、図９（ａ）に示すように、熱電半導体膜上に銅薄膜の対向電極膜２８（約１μｍ厚さ）を上記と同様の方法を用いて製膜する。

【００４２】次に、図８（ａ）～図８（ｃ）で示したのと同様な方法により、他方のアルミニウム板１８ｂの面にも、パターニングされた取り出し電極膜２４を形成したポリイミド樹脂フィルムの絶縁膜１０ｂを熱的に接着し、図９（ｂ）に示す上部基板を作製する。

【００４３】最後に、上部基板上に形成した取り出し電極膜２４上に所定のパターンのクリーム半田層を印刷した後、取り出し電極膜２４と銅薄膜の対向電極膜２８が接触するように組み合わせ、昇温して半田層を硬化して、電気的接合を確保する。このようにして、図９（ｃ）に示すように、製膜されたすべてのＰ型熱電半導体膜２６とＮ型熱電半導体膜２７が電気的に直列で、かつ熱的に並列であるような熱電装置を作製することができる。

【００４４】以上のように、本実施例によれば、基板を機械加工することなく銅製の突起を絶縁板上に配置して、加熱するだけで容易に絶縁板上に突起を形成することができるため、一層、量産性に優れ、製造コストを下げることが可能となる。

【００４５】（実施例３）図１０は本発明の第３の実施例の縦断面図である。

【００４６】本実施例では、第１および第２の実施例で示した２枚の上下絶縁板に挟まれた構成を有する熱電装置を、熱的接触を確保しながら３段に積層したものである。第１段目の熱電装置の上部の絶縁板２９は第２段目の熱電装置の下部の絶縁板として用い、また第２段目の熱電装置の上部の絶縁板３０は、第３の段目の熱電装置の下部の絶縁板として用いている。そして、上段になるほど、１枚の絶縁板上に形成される熱電半導体膜の数、すなわち熱電素子の数を少なくしている。なお、各段の熱電装置に用いる熱電半導体膜の材料を、各段の温度において材料の性能指数が高くなるように変化させている。すなわち、１段目および２段目にはＢｉ－Ｔｅ系材料を、３段目にはＢｉ－Ｓｂ系材料を用いた。

【００４７】以上のように構成された熱電装置に電流を流せば、熱電装置の最上部の絶縁板３１と最下部の絶縁板３２の間に生じる温度差は、第１段から第３段のそれぞれの熱電装置で発生する温度差の総和となる。

【００４８】したがって、本実施例では、第１および第２の実施例で述べた効果に加えて、薄い熱電装置を複数枚積層することによって、熱電装置全体として発生する温度差を増大できるという効果が得られる。また、各段で用いる熱電半導体をその温度域で性能が高くなる材料としたため、効率よく大きな温度差が得られる。

【００４９】さらに、熱電半導体を薄膜としたため、熱電装置全体の厚さを薄くすることが可能となり、コンパクト熱電装置を実現できる。

【００５０】（実施例４）図１１は本発明の第４の実施例の縦断面図である。

【００５１】本実施例では、図１０に示した熱電装置の下部に熱交換手段（放熱手段）として水冷のための冷却路３３を設けた放熱器３４を設置している。すなわち、

図１０の熱電装置の最下部の絶縁板３２の他面に放熱器３４を熱伝導性接着剤で接着して熱的に接触させている。

【００５２】このような構成とすることにより、発熱部における放熱をより効率よく行うことが可能となり、冷却効果をより高めることができる。

【００５３】なお、第１の実施例における突起９および第２の実施例における電極部２５の形状は四角錐としたが、先細りの柱状構造であれば、いかなる形状の断面であっても同様の効果が得られる。

【００５４】また、絶縁板をアルミニウム板の表面上に絶縁膜を形成したもので説明したが、アルミなどの絶縁板を用いてもよい。

【００５５】

【発明の効果】以上のように本発明によれば、熱的非平衡状態のもとで作製した性能の高い熱電半導体膜を用いるため、従来より熱電変換効率が高く、小型・軽量で安価な熱電装置が得られる。

【図面の簡単な説明】

【図１】本発明の第１の実施例における熱電装置の要部拡大縦断面図

【図２】同実施例における平面図

【図３】同実施例における縦断面図

【図４】同実施例における要部拡大横断面図

【図５】（ａ）～（ｅ）同実施例の前半の製造工程図

【図６】（ａ）～（ｄ）同実施例の後半の製造工程図

【図７】本発明の第２の実施例における要部拡大縦断面図

【図８】（ａ）～（ｅ）同実施例の前半の製造工程図

【図９】（ａ）～（ｃ）同実施例の後半の製造工程図

【図１０】第３の実施例の縦断面図

【図１１】第４の実施例の縦断面図

【図１２】従来の熱電装置の斜視図

【符号の説明】

９　突起

１１，１９，１９ａ，１９ｂ，２９，３０，３１，３２　絶縁板

１２，２３　電極膜

１３，２６　Ｐ型熱電半導体膜

１４，２７　Ｎ型熱電半導体膜

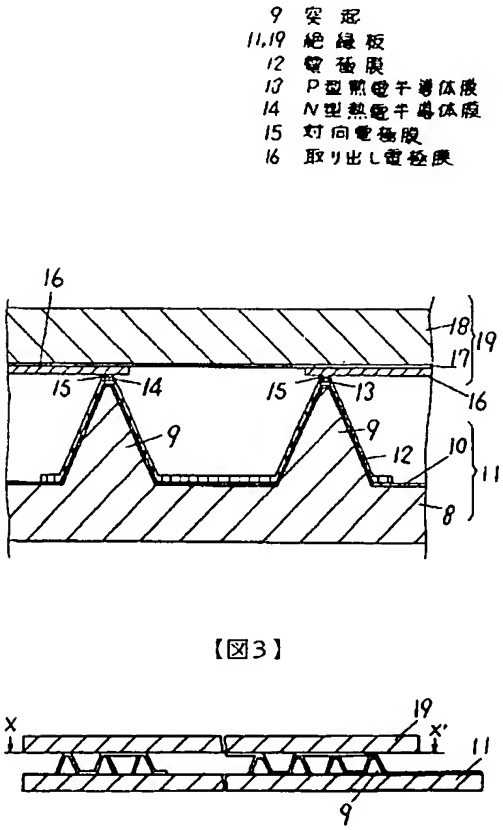
１５，２８　対向電極膜

１６，２４　取り出し電極膜

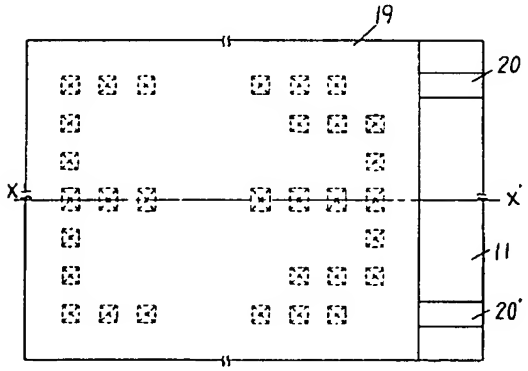
２５　電極部

３４　放熱器（熱交換手段）

【図１】

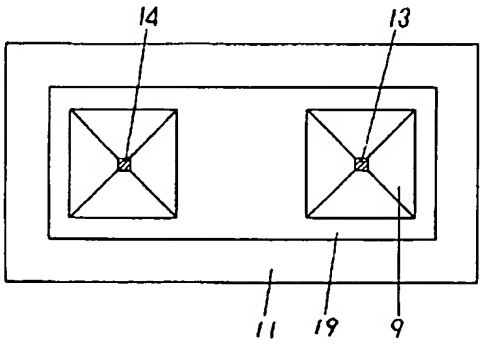


【図２】



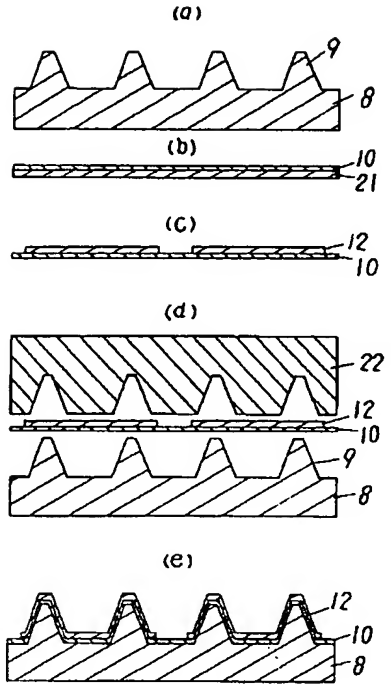
【図３】

【図４】



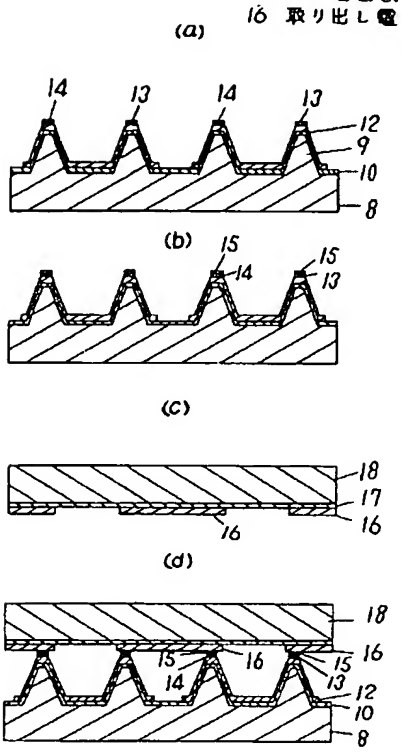
【図5】

9　突起
12　電極膜



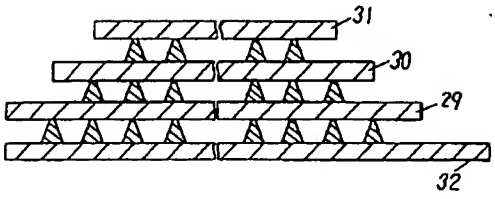
【図6】

13　P型熱電半導体膜
14　N型熱電半導体膜
15　対向電極膜
16　取り出し電極膜



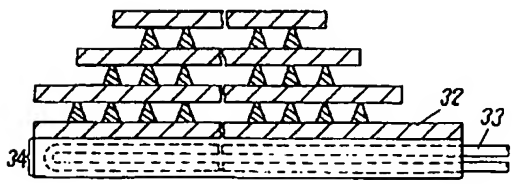
【図10】

29,30,31,32　絶縁板



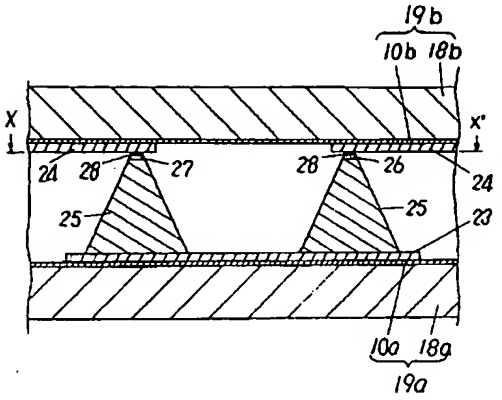
【図11】

34　放熱器
（熱交換手段）



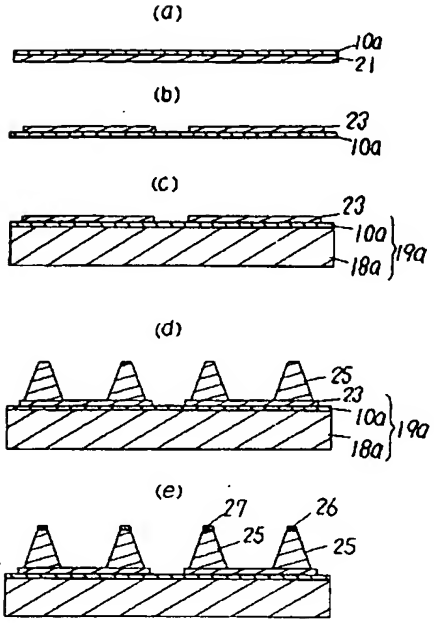
【図7】

19a/19b　絶縁板
23　電極膜
24　取り出し電極膜
25　電極部
26　P型熱電半導体膜
27　N型熱電半導体膜
28　対向電極膜



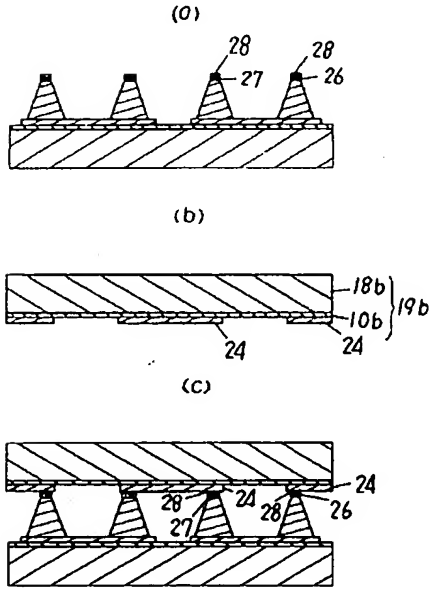
【図8】

19a　絶縁板
23　電極膜
25　電極部
26　P型熱電半導体膜
27　N型熱電半導体膜

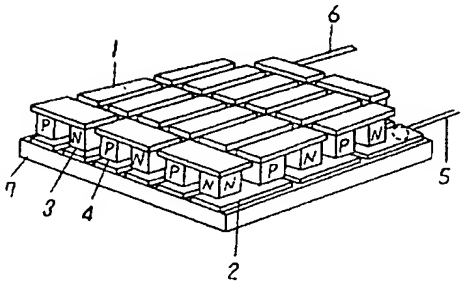


【図9】

19b　絶縁板
24　取り出し電極
28　対向電極膜



【図12】



フロントページの続き

(72)発明者　行天　久朗
大阪府門真市大字門真1006番地　松下電器
産業株式会社内

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 05-226704
(43)Date of publication of application : 03.09.1993

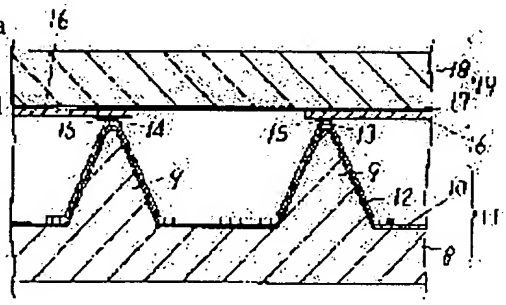
(51)Int.CI. H01L 35/32
H01L 35/34

(21)Application number : 04-023503
(22)Date of filing : 10.02.1992

(71)Applicant : MATSUSHITA ELECTRIC IND CO LTD
(72)Inventor : NISHIWAKI FUMITOSHI
NAKAGIRI YASUSHI
YAMAMOTO YOSHIAKI
GYOTEN HISAAKI

(54) THERMOELECTRIC DEVICE AND ITS MANUFACTURE

(57)Abstract:
PURPOSE: To provide a small, light, and inexpensive thermoelectric device high in thermoelectric conversion efficiency and its manufacture.
CONSTITUTION: At least a pair of projections 9 are provided at one side of one insulating plate 11, and a patterned electrode film 12 is provided between a pair of projections 9, and a p-type thermoelectric semiconductor film 13, on the electrode film 12 at one top of the projections 9 in a pair, and an n-type thermoelectric semiconductor film 14, on the electrode film 12 on the other top, are provided, and counter electrodes 15, which form a pair, are provided on the p-type thermoelectric semiconductor film 13 and the n-type thermoelectric semiconductor 14, and a pair of lead electrode films 16 are provided for the counter electrode films 15, and a pair of lead electrodes 16 are provided on one side of the other insulating plate 19.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] this invention relates to the thermoelectrical equipment used for cooling and the heating apparatus which performs an endothermic or thermolysis electrically by the Peltier effect, or the power plant which generates electricity by the Seebeck effect using a temperature gradient, and its manufacture technique.
[0002]
[Description of the Prior Art] the conventional thermoelectrical equipment is shown in drawing 12 -- as -- metal plates 1 and 2 -- the N type thermoelectric semiconductor 3 and the P type thermoelectric semiconductor 4 -- putting -- them -- alternation -- ** -- electrically, in series, if it arranges in parallel thermally and potential is given between a terminal 5 and the terminal 6, one metal plate will be cooled and another side will be heated 7 is an electric insulating plate. (For example, Kamimura and Nishida work "thermoelectric-semiconductor and its application" Nikkan Kogyo Shimbun (1988) p.39) Such manufacture technique of thermoelectrical equipment is performed as follows.
[0003] As a thermoelectric semiconductor, the Bi-Te system compound is mainly used, a block of P type and N type is produced using processes, such as an ingot and sintering, and a block of the thermoelectric semiconductor is fabricated in a predetermined bulk configuration using a diamond cutter etc. The configuration of a thermoelectric semiconductor has the common shape of a circular cylinder in the shape of a prism. By the shape of a prism, the size has an about 1.4mmx1.4mmx1.7mm] size, even when the smallest. A copper plate is used for a metal plate. And a thermoelectric semiconductor and a metal plate are directly soldered by the Bi-Sn system eutectic alloy etc., and it was joined so that it might become the configuration which put the P type thermoelectric semiconductor 4 and the N type thermoelectric semiconductor 3 by turns, and connected in series electrically, and was thermally connected in parallel with many metal plates.
[0004] an expansion of a refrigeration capacity makes the installation number of a thermoelectric semiconductor increase -- moreover, the expansion of the temperature gradient of the cooling section and the exoergic section was performed by carrying out the laminating of the equipment shown in drawing 12 to multi-stage
[0005]
[Problem(s) to be Solved by the Invention] However, there was the following problem by the above conventional thermoelectrical equipment and its manufacture technique.
(1) The thermoelectric semiconductor of the bulk produced by processes, such as an ingot and sintering, was difficult to raise the performance, and its luminous efficacy was low.
(2) Since it is a brittle material, a thermoelectric semiconductor is a predetermined bulk configuration (for example, in case it fabricated to about [1.4mmx1.4mmx1.7mm], a corner tended to be missing and the yield was very low.).
(3) Since it was difficult for a size to vary the above thermoelectric semiconductors [a large number (about about 200 pieces)], and for there to be nothing and to arrange P type and N type correctly by turns moreover in a small size very much, the yield was very low.
(4) It was difficult to be unable to make the size of a thermoelectric semiconductor small, therefore to produce the thin thermoelectrical equipment [as / whose thickness of a thermoelectric semiconductor is 1mm or less] because of the technical probrem on the above-mentioned manufacture.
(5) In order for a manufacturing process to produce each parts continuously, respectively and to assemble, when manufacturing in large quantities, in order that taking time and time and lowering a manufacturing cost may use difficult (6) rare metals in large quantities, a material cost becomes high and the weight and capacity of thermoelectrical equipment become large.
(7) When the laminating tended to be carried out with the cascade method and it was going to enlarge low temperature and the hot temperature gradient, thickness increased and the weight was increasing.
[0006] this invention solves the above-mentioned problem, and a thermoelectrical conversion efficiency is high and aims it at offer of small, lightweight, and cheap thermoelectrical equipment and its manufacture technique.
[0007]
[Means for Solving the Problem] In order to attain the above-mentioned purpose the thermoelectrical equipment of this invention Prepare at least one pair of salients in the whole surface of one electric insulating plate, and the electrode layer by which patterning was carried out among one pair of the salients is prepared. An N type thermoelectric-semiconductor layer is prepared on a layer and the electrode layer of the crowning of another side. the 1 above-mentioned pair of electrode layer top of one crowning of a salient -- P type thermoelectricity -- a conductor -- The counterelectrode layer used as one pair is prepared on the P type thermoelectric-semiconductor layer and an N type thermoelectric-semiconductor layer, one pair of ejection electrode layers by which patterning was carried out in contact with the counterelectrode layer are prepared, and one pair of the ejection electrode layers consider as the configuration prepared in the whole surface of the electric insulating plate of another side.
[0008]
[Function] According to the above-mentioned configuration, it is based on the ability of the good thermoelectrical equipment

of the thermoelectric-semiconductor layer with a high performance, and a heat insulation produced under thermal non-equilibrium to be constituted.

[0009]

[Example] (Example 1) The 1st example of this invention is explained below based on an accompanying drawying.

[0010] Drawing 1 is an important section enlarged vertical longitudinal sectional view of this example. In this drawing, while produced the salient 9 by technique, such as machining, on the front face, and 8 is an aluminum substrate. One pair of salients 9 are the square weight of the height of 1mm, 0.1mm of the top openings, and 1mm of the pars-basilaris-ossis-occipitalis openings, and are formed in 2.2mm pitch. As an electric-insulation layer, the polyimide-resin film 10 with a thickness of 30 micrometers is formed in the whole surface of one aluminum substrate 8, and one electric insulating plate 11 is formed in it. Furthermore, the electrode layer 12 (70 micrometers in thickness) by which patterning was carried out is formed in the top. An electrode layer 12 connects electrically the top comrade of the salient 9 of one pair of ****** in series, and patterning is carried out to the electrode layer prepared in the crowning of other salients so that it may insulate. On one pair of electrode layers 12 of the crowning of salient 9, vacuum deposition, thermal spraying, etc. form the P type thermoelectric-semiconductor layer 13 and the N type thermoelectric-semiconductor layer 14 for technique, carrying out **** masking. The counterelectrode layer 15 used as one pair is formed on the P type thermoelectric-semiconductor layer 13 and the N type thermoelectric-semiconductor layer 14. In contact with the counterelectrode layer 15, one pair of ejection electrode layers 16 are formed, and it is prepared in the whole surface of the electric insulating plate 19 of another side where one pair of the ejection electrode layers 16 consist of an aluminum plate 18 of another side through the insulator layer 17 of a polyimide-resin film with a thickness of 30 micrometers.

[0011] In the case of the thermoelectric-semiconductor layer 13 and film production of 14, a mask pattern which becomes in-series electrically by turns about the layers 13 and 14 is adopted, and patterning of the ejection electrode layer 16 is carried out at it so that it may depend in parallel thermally.

[0012] Drawing 2 prepares many **s and thermoelectric-semiconductor layers of drawing 1 with the plan of this example, and finally the ejection electrode layer 16 is pulled out and connected to the electrode 20 and 20'. Similarly drawing of longitudinal section and the drawing 4 where drawing 3 met the X-X' line of drawing 2 are an important section expansion cross-sectional view.

[0013] In the thermoelectrical equipment constituted as mentioned above, if direct current voltage is impressed between the cash-drawer electrode 20 and 20', an endothermic or generation of heat will arise by the Peltier effect by the interface of the P type thermoelectric-semiconductor layer 13 N-type thermoelectric-semiconductor layer 14, the electrode layer 12, and the ejection electrode layer 16. Consequently, it can cool by one side of the vertical electric insulating plate of thermoelectrical equipment, and can heat on the other hand. That is, the direct conversion of the electrical and electric equipment and heat becomes possible.

[0014] In addition, although one side of an electric insulating plate serves as low temperature, another side serves as an elevated temperature at this time and a temperature gradient arises among both plates, the salient 9 with a height of 1mm is formed on an electric insulating plate 11, and most heat loss by heat conduction through the air which exists from an elevated-temperature side electric insulating plate between them to a low temperature side electric insulating plate can be disregarded by having set distance between an electric insulating plate 11 and the electric insulating plate 19 to about 1mm.

[0015] According to this example, luminous efficacy of thermoelectrical equipment can be made remarkably high as mentioned above compared with the former by considering as the thin film with the high performance which produced the thermoelectric semiconductor under thermal non-equilibrium.

[0016] Moreover, it enables dispersion in a configuration for position precision to be good and to form the thermoelectric-semiconductor layer of a detailed layer configuration few moreover on an electrode layer, since the batch film production of the thermoelectric semiconductor can be carried out, masking using film production processes, such as vacuum deposition. Furthermore, since a thermoelectric semiconductor is mounted with high density, it becomes possible to make the amount of endothermics per unit area increase, and thermoelectrical equipment can be used also for cooling of the big equipment of an exoergic density.

[0017] Furthermore, thermoelectric material is written as a thin film, the amount of rare metals, such as Bi to use and Te, becomes small, and the cost of material cost **, as a result thermoelectrical equipment can be reduced.

[0018] As mentioned above, although the case where the thermoelectrical equipment of this example is used as a cooling system has been explained, the thermoelectrical equipment which has this configuration cannot be overemphasized by that it can use as a power plant which changes heat into the electrical and electric equipment using the Seebeck effect.

[0019] The drawing 5 and the drawing 6 explain the manufacture technique of the thermoelectrical equipment of this example. First, as shown in drawing 5 (a), one aluminum plate 18 of 2mm thickness is machined, and the salient 9 of much square weight of the size of the height of 1mm, 0.1mm of the top openings, and 1mm of the pars-basilaris-ossis-occipitalis openings is formed in 2.2mm pitch on the 1mm aluminum plate 8 of thickness.

[0020] Next, as shown in (b), on copper foil 21 with a thickness of 70 micrometers, a polyamide resin solution is applied and stiffened and the insulator layer 10 of a polyimide-resin film with a thickness of 30 micrometers is formed.

[0021] Next, as shown in (c), patterning of the copper foil 21 is carried out to a predetermined configuration using a lithography method of construction, and an electrode layer 12 is formed on an insulator layer 10.

[0022] Next, as shown in (d), the aluminum plate 8 which formed the salient 9 produced by (a) is made into a male press die, and press working of sheet metal of the insulator layer 10 of a polyimide-resin film which formed the electrode layer 12 is carried out using the female press die 22 corresponding to the salient 9. The adhesives of an epoxy system are applied to the front face of an aluminum plate 8 in which the salient 9 was formed in that case. Consequently, what joined thermally the insulator layer 10 of a polyimide-resin film which formed the electrode layer 12 on the aluminum plate 8 which is shown in (e) can be formed. In addition, an electrode layer 12 connects the top comrade of a salient of two ******s in series electrically, and patterning is carried out to the electrode layer formed in the crowning of other salients so that it may insulate.

[0023] Next, the N type thermoelectric-semiconductor layer 14 is produced in the P type thermoelectric-semiconductor layer 13, using and masking technique, such as vacuum deposition and thermal spraying, on the electrode layer 12 of the crowning

of salient 9, as shown in drawing 6 (a). The configuration of a thermoelectric-semiconductor layer is 10 micrometers in 100 micrometers xwide 100 micrometersx thickness of ****s. The thermoelectric-semiconductor layer is producing the film so that the P type thermoelectric-semiconductor layer 13 and the N type thermoelectric-semiconductor layer 14 may become by turns.

[0024] Next, as shown in (b), on a thermoelectric-semiconductor layer, the same technique is used and the orientation electrode layer 15 (about 1 micrometer thickness) of a copper thin film is produced.

[0025] Next, the insulator layer 17 of the polyimide-resin film by which patterning was carried out and which took out and formed the electrode layer 16 is thermally pasted up also on one front face of the aluminum plate 18 of another side by the same technique, and the upside substrate shown in drawing 6 (c) is produced as drawing 5 (b) - (d) showed.

[0026] Finally, after [which was formed in one field of an aluminum plate 18] taking out and printing the cream solder layer of a predetermined pattern on an electrode layer 16, a temperature up is combined and carried out, a solder layer is hardened so that the counterelectrode layer 15 formed on the ejection electrode layer 16, and the P type thermoelectric-semiconductor layer 13 and the N type thermoelectric-semiconductor layer 14 may contact, and the electric junction is secured. Thus, as shown in drawing 6 (d), the thermoelectrical equipment all the produced P type thermoelectric-semiconductor layers 13 and whose N type thermoelectric-semiconductor layer 14 are thermally [in series] parallel electrically is producible.

[0027] In addition, although the laminated material of the insulator layer 10 of copper foil 21 and a polyimide-resin film was produced in this example by applying and stiffening a polyamide resin solution and forming the insulator layer 10 of a polyimide-resin film on copper foil 21, you may use the copper-clad laminate of marketing which has the same configuration.

[0028] As mentioned above, since the batch film production of a P type thermoelectric-semiconductor layer and the N type thermoelectric-semiconductor layer can be carried out on an electrode layer according to this example, masking using a vacuum film production process, it is enabled for position precision to be good, and for a configuration to vary moreover, and to form the thermoelectric semiconductor of a predetermined layer configuration few. Consequently, it is possible for the yield to be good and to manufacture thermoelectrical equipment in large quantities by the low cost. Furthermore, large-area-izing of a manufacture process is easy, and since it can carry out by the continual process, it excels in mass-production nature and is enabled to lower a manufacturing cost. Moreover, since a vacuum film production process is used, it becomes easy to control the crystal-growth side of a thermoelectric-semiconductor layer, and it can raise the performance of thermoelectric material much more.

[0029] (Example 2) View 7 is the important section enlarged vertical longitudinal sectional view of the 2nd example of this invention.

[0030] In this drawing, one pair of aluminum plates 18a and 18b are 1mm in thickness, and the insulator layers 10a and 10b of a polyimide-resin film with a thickness of 30 micrometers are formed in the whole surface of one pair of the aluminum plates 18a and 18b, and they constitute electric insulating plates 19a and 19b on it. And the electrode layer 23 by which patterning was carried out on one field of one electric insulating plate 19a takes out similarly on one field of electric insulating plate 19b of another side, and the electrode layer 24 (all are micrometers [in thickness / 70], the width of face of 1.4mm, and the length of 3.6mm) is formed. The copper polar zone 25 of at least one pair of letters of a salient is formed at the spacing of 2.2mm on the electrode layer 23 formed on one electric insulating plate 19a, and one pair of polar zone 25 is joined electrically. This polar zone 25 is the square weight of the height of 1mm, 0.1mm angle of top, and 1mm angle of pars basilaris ossis occipitalis. On this polar zone 25, the P type thermoelectric-semiconductor layer 26 and the N type thermoelectric-semiconductor layer 27 are produced, masking using technique, such as vacuum deposition and thermal spraying, and the counterelectrode layer 28 of a copper thin film is further produced on the top using the same technique. At the time of film production of a thermoelectric-semiconductor layer, a mask pattern which the P type thermoelectric-semiconductor layer 26 and the N type thermoelectric-semiconductor layer 27 become by turns was adopted in the ****** polar zone 25. And it is assembled so that the counterelectrode layer 28 of the copper thin film prepared on the P type thermoelectric-semiconductor layer 26 and the N type thermoelectric-semiconductor layer 27 and the ejection electrode layer 24 prepared in the whole surface of electric insulating plate 19b of another side may join electrically. In addition, patterning of the electrode layer 23 and the ejection electrode 24 is carried out so that all the P type thermoelectric-semiconductor layers 26 and the N type thermoelectric-semiconductor layer 27 which were produced may become parallel thermally in series electrically.

[0031] The point different from the 1st example is a point which considered the polar zone 25 which forms a thermoelectric-semiconductor layer on it as the copper square weight block instead of a thin film.

[0032] If a current is passed to the thermoelectrical equipment constituted as mentioned above, an endothermic or generation of heat will arise by the Peltier effect by the interface of the P type thermoelectric-semiconductor layer 26, the N type thermoelectric-semiconductor layers 27 and 25, and the counterelectrode layer 28 of a copper thin film. Consequently, it can cool by one side of the vertical electric insulating plate of thermoelectrical equipment, and can heat on the other hand. That is, the direct conversion of the electrical and electric equipment and heat becomes possible.

[0033] According to this example, it is enabled to make luminous efficacy of thermoelectrical equipment remarkably high as a thermoelectric semiconductor compared with the former by using the thermoelectric semiconductor with the high performance produced under thermal non-equilibrium as mentioned above.

[0034] Moreover, since the polar zone 25 was made into the copper of square weight and the passage cross section of a current was made to increase, compared with the case where the polar zone is a thin film, the amount of heat loss by joule generation of heat in the polar zone can be reduced. Therefore, it becomes possible to make the amount of endothermics of thermoelectrical equipment increase, and luminous efficacy of thermoelectrical equipment can be made high much more.

[0035] Moreover, a reduction of the cost by the amount of the thermoelectric material which the refrigeration capacity per unit area by mounting a thermoelectric semiconductor with high density increases and uses like the 1st example becoming small can be aimed at.

[0036] The drawing 7 and the drawing 8 explain the manufacture technique of the thermoelectrical equipment of this example. First, as shown in drawing 8 (a), on copper foil 21 with a thickness of 70 micrometers, a polyamide resin solution is applied and stiffened and insulator layer 10a of a polyimide-resin film with a thickness of 30 micrometers is formed.

[0037] Next, as shown in (b), patterning of the copper foil 21 is carried out to a predetermined configuration using a lithography method of construction, and an electrode layer 23 (micrometers [in thickness / 70], the width of face of 1.4mm, the length of 3.6mm) is formed on insulator layer 10a of a polyimide-resin film.
[0038] Next, as shown in (c), after applying the adhesives of an epoxy system to the field of aluminum plate 18a, insulator layer 10a of a polyimide ** film which formed the electrode layer 23 is installed and stiffened, both are joined thermally, and one electric insulating plate 19a is manufactured.
[0039] Next, as shown in (d), the copper polar zone 25 of one pair of letters of a salient is installed at least at the spacing of 2.2mm on an electrode layer 23, and both are joined electrically. The polar zone 25 is a copper block of the square weight of the height of 1mm, 0.1mm angle of top, and 1mm angle of pars basilaris ossis occipitalis, is processed mechanically and produced. And after arranging a copper block of the produced square weight on the female (not shown) which formed the concavity of square weight in the position, it is made to arrange on an electrode layer 23 collectively. In addition, on an electrode layer 23, cream solder is applied beforehand. Then, a temperature up is carried out and the copper polar zone 25 of an electrode layer 23 and square weight is joined electrically.
[0040] Next, as shown in (e), in the crowning of the polar zone 25 of square weight, the P type thermoelectric-semiconductor layer 26 and the N type thermoelectric-semiconductor layer 27 are produced, using and masking technique at vacuum deposition, thermal spraying's, etc. The configuration of the thermoelectric-semiconductor layers 26 and 27 is 10 micrometers in 100 micrometers xwide 100 micrometersx thickness of ****s. The thermoelectric-semiconductor layer is producing the film so that the P type thermoelectric-semiconductor layer 26 and the N type thermoelectric-semiconductor layer 27 may become by turns.
[0041] Furthermore, as shown in drawing 9 (a), the counterelectrode layer 28 (about 1 micrometer thickness) of a copper thin film is used and produced for the same technique as the above on a thermoelectric-semiconductor layer.
[0042] Next, insulator layer 10b of the polyimide-resin film by which patterning was carried out also to the field of aluminum plate 18b of another side and which took out and formed the electrode layer 24 is thermally pasted up by the same technique, and the up substrate shown in drawing 9 (b) is produced as drawing 8(a) - view 8 (c) showed.
[0043] Finally, after [which was formed on the up substrate] taking out and printing the cream solder layer of a predetermined pattern on an electrode layer 24, a temperature up is combined and carried out, a solder layer is hardened so that the counterelectrode layer 28 of the ejection electrode layer 24 and a copper thin film may contact, and an electric junction is secured. Thus, as shown in drawing 9 (c), the thermoelectrical equipment all the produced P type thermoelectric-semiconductor layers 26 and whose N type thermoelectric-semiconductor layer 27 are thermally [in series] parallel electrically is producible.
[0044] As mentioned above, since a salient can be easily formed on an electric insulating plate only by arranging and heating a copper salient on an electric insulating plate according to this example, without machining a substrate, much more, it excels in mass-production nature and is enabled to lower a manufacturing cost.
[0045] (Example 3) View 10 is drawing of longitudinal section of the 3rd example of this invention.
[0046] In this example, the laminating of the thermoelectrical equipment which has the configuration inserted into the vertical electric insulating plate of two sheets shown in the 1st and 2nd examples is carried out to three steps, securing a thermal contact. The electric insulating plate 29 of the upper part of the 1st-step thermoelectrical equipment is used as an electric insulating plate of the lower part of the 2nd-step thermoelectrical equipment, and the electric insulating plate 30 of the upper part of the 2nd-step thermoelectrical equipment is used as an electric insulating plate of the lower part of the 3rd thermoelectrical equipment of eye a card row. And the number of the thermoelectric-semiconductor layers formed on the electric insulating plate of one sheet, i.e., the number of thermoelements, is lessened so that it becomes an upper case. In addition, the material of the thermoelectric-semiconductor layer used for the thermoelectrical equipment of each card row is changed so that the performance index of a material may become high in the temperature of each card row. That is, the Bi-Te system material was used for the 1st step and the 2nd step, and the Bi-Sb system material was used for the 3rd step.
[0047] If a current is passed to the thermoelectrical equipment constituted as mentioned above, the temperature gradient produced between the electric insulating plate 31 of the top of thermoelectrical equipment and the lowermost electric insulating plate 32 will serve as total of the temperature gradient generated with each the 1st step to 3rd-step thermoelectrical equipment.
[0048] Therefore, in addition to the effect stated in the 1st and 2nd examples, in this example, the effect that the temperature gradient generated as the whole thermoelectrical equipment can be increased is acquired by carrying out two or more sheets laminating of the thin thermoelectrical equipment. Moreover, the thermoelectric semiconductor used in each card row is written as the material to which a performance becomes high in the temperature region, and an efficient big temperature gradient is acquired.
[0049] Furthermore, a thermoelectric semiconductor is written as a thin film, it is enabled to make thickness of the whole thermoelectrical equipment thin, and compact thermoelectrical equipment can be realized.
[0050] (Example 4) View 11 is drawing of longitudinal section of the 4th example of this invention.
[0051] In this example, the radiator 34 which established the cooling way 33 for water cooling in the lower part of the thermoelectrical equipment shown in drawing 10 as a heat-exchange means (thermolysis means) is installed. that is, on the other hand, the electric insulating plate 32 of the bottom of the thermoelectrical equipment of drawing 10 is alike, a radiator 34 is pasted up with thermally conductive adhesives, and it is made to contact thermally
[0052] By considering as such a configuration, it is enabled to perform the thermolysis in the exoergic section more efficiently, and the cooling effect can be raised more.
[0053] In addition, although the configuration of the salient 9 in the 1st example and the polar zone 25 in the 2nd example was used as square weight, if it is a tapering columnar structure, the same effect will be acquired even if it is the cross section of which configuration.
[0054] Moreover, although it is the thing in which the insulator layer was formed on the front face of an aluminum plate and the electric insulating plate was explained, you may use electric insulating plates, such as aluminum.
[0055]
[Effect of the Invention] In order to use the thermoelectric-semiconductor layer with the high performance produced under

thermal non-equilibrium as mentioned above according to this invention, a thermoelectrical conversion efficiency is higher than the former, and small, lightweight, and cheap thermoelectrical equipment is obtained.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] Prepare at least one pair of salients in the whole surface of one electric insulating plate, and the electrode layer by which patterning was carried out among one pair of the salients is prepared. An N type thermoelectric-semiconductor layer is prepared on a P type thermoelectric-semiconductor layer and the electrode layer of the crowning of another side on the one above-mentioned pair of electrode layers of one crowning of a salient. Thermoelectrical equipment with which the counterelectrode layer used as one pair is prepared on the P type thermoelectric-semiconductor layer and an N type thermoelectric-semiconductor layer, one pair of ejection electrode layers by which patterning was carried out in contact with the counterelectrode layer are prepared, and one pair of the ejection electrode layers are prepared in the whole surface of the electric insulating plate of another side.

[Claim 2] Prepare the electrode layer by which patterning was carried out on one electric insulating plate, and at least one pair of polar zone is prepared on the electrode layer. An N type thermoelectric-semiconductor layer is prepared in one crowning of the one aforementioned pair of polar zone at the crowning of a P type thermoelectric-semiconductor layer and another side. Thermoelectrical equipment with which the counterelectrode layer used as one pair is prepared on the P type thermoelectric-semiconductor layer and an N type thermoelectric-semiconductor layer, one pair of ejection electrode layers by which patterning was carried out in contact with the counterelectrode layer are prepared, and one pair of the ejection electrode layers are prepared in the whole surface of the electric insulating plate of another side.

[Claim 3] Thermoelectrical equipment which carried out the laminating of the thermoelectrical equipment according to claim 1 or 2 more than two-layer.

[Claim 4] the thermoelectrical equipment which established the heat-exchange means which one electric insulating plate of thermoelectrical equipment according to claim 1, 2, or 3 was alike on the other hand, and contacted thermally

[Claim 5] The process which forms at least one pair of salients in the whole surface of one electric insulating plate, and the process which forms the electrode layer by which patterning was carried out on the above-mentioned whole surface, The process which forms an N type thermoelectric-semiconductor layer on a P type thermoelectric-semiconductor layer and the electrode layer of the crowning of another side on the one above-mentioned pair of electrode layers of one crowning of a salient, The process which forms a counterelectrode layer on the above-mentioned P type thermoelectric-semiconductor layer and an N type thermoelectric-semiconductor layer, The manufacture technique of the thermoelectrical equipment which consists of a process by which patterning was carried out on the whole surface of the electric insulating plate of another side, and which takes out and forms an electrode layer, and a process to which the whole surface of above-mentioned one electric insulating plate and the whole surface of the electric insulating plate of above-mentioned another side are joined electrically.

[Claim 6] The process which forms the electrode layer by which patterning was carried out to the whole surface of one electric insulating plate, The process which forms at least one pair of polar zone on the above-mentioned electrode layer, and the process which forms an N type thermoelectric-semiconductor layer in one crowning of the one aforementioned pair of polar zone at the crowning of a P type thermoelectric-semiconductor layer and another side, The process which forms a counterelectrode layer on the above-mentioned P type thermoelectric-semiconductor layer and an N type thermoelectric-semiconductor layer, The manufacture technique of the thermoelectrical equipment which consists of a process by which patterning was carried out on the whole surface of the electric insulating plate of another side, and which takes out and forms an electrode layer, and a process to which the whole surface of above-mentioned one electric insulating plate and the whole surface of the electric insulating plate of above-mentioned another side are joined electrically.

[Translation done.]

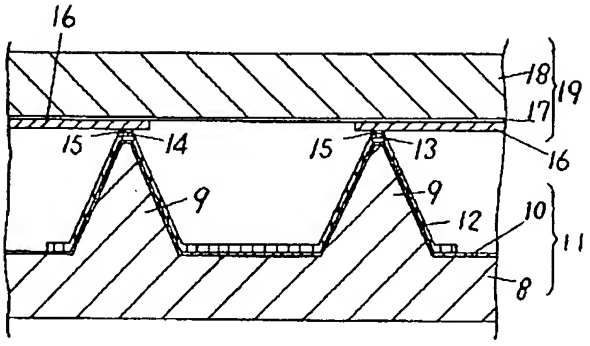
* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

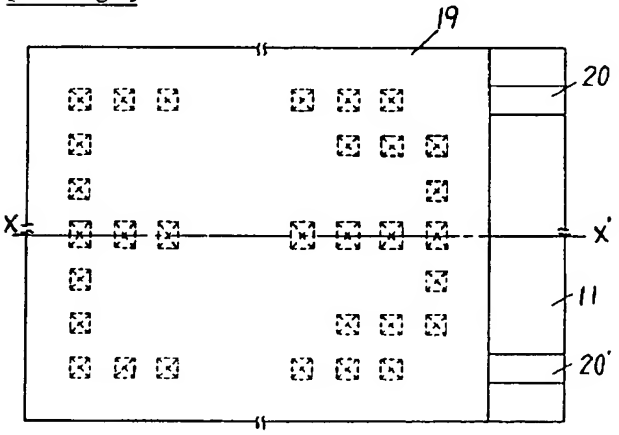
DRAWINGS

[Drawing 1]

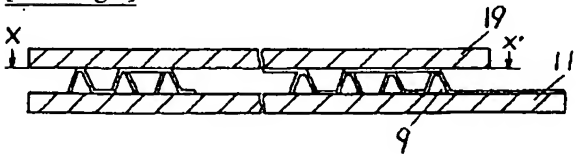
9 突起
11,19 絶縁板
12 電極膜
13 P型熱電半導体膜
14 N型熱電半導体膜
15 対向電極膜
16 取り出し電極膜



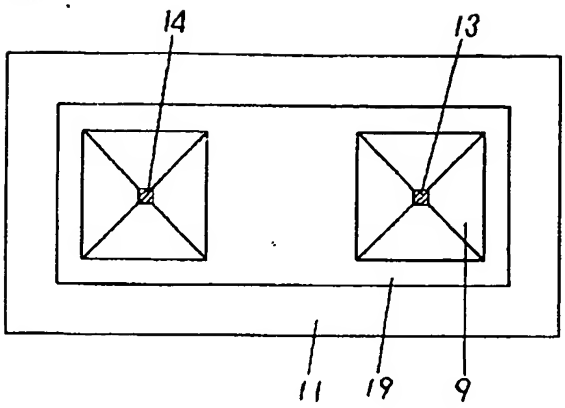
[Drawing 2]



[Drawing 3]

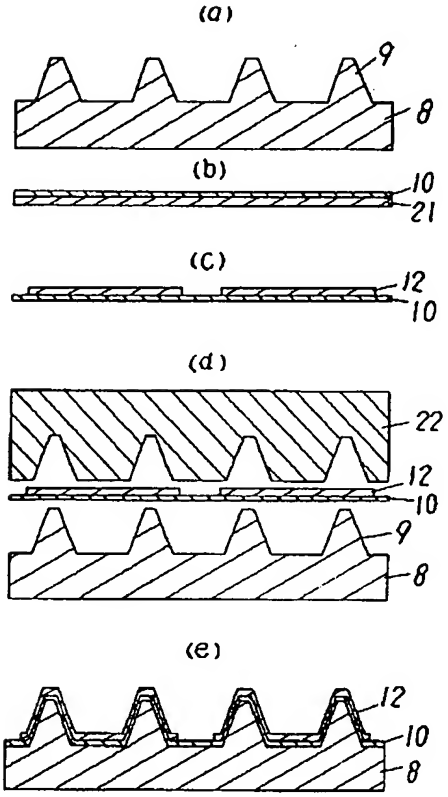


[Drawing 4]



[Drawing 5]

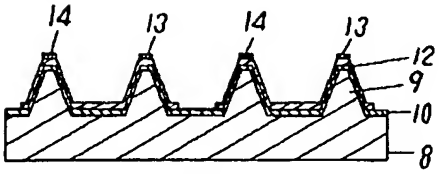
9 突起
12 電極膜



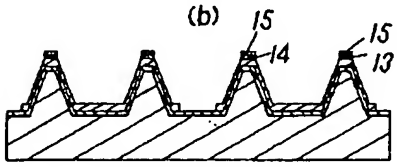
[Drawing 6]

13 P型熱電半導体膜
14 N型熱電半導体膜
15 対向電極膜
16 取り出し電極膜

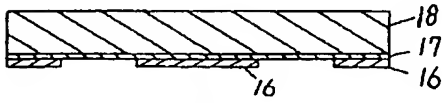
(a)



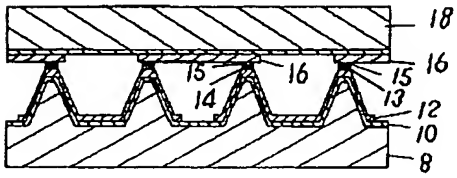
(b)



(c)

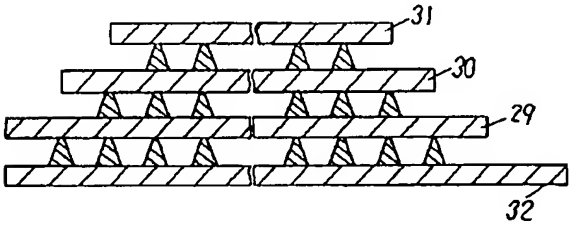


(d)



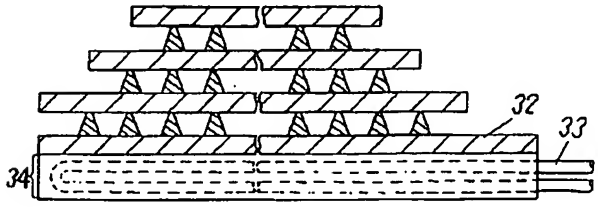
[Drawing 10]

29,30,31,32 絶縁板



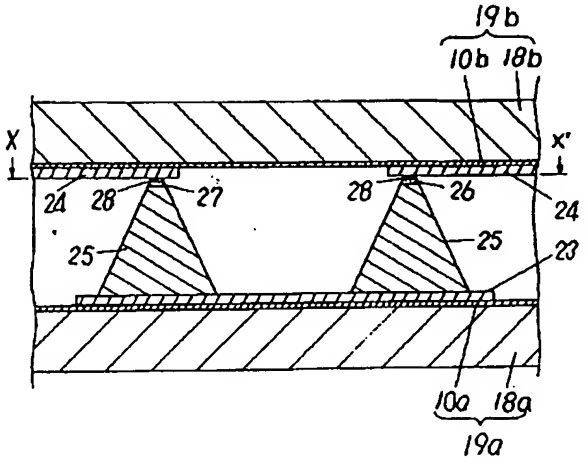
[Drawing 11]

34 放熱器
(熱交換手段)



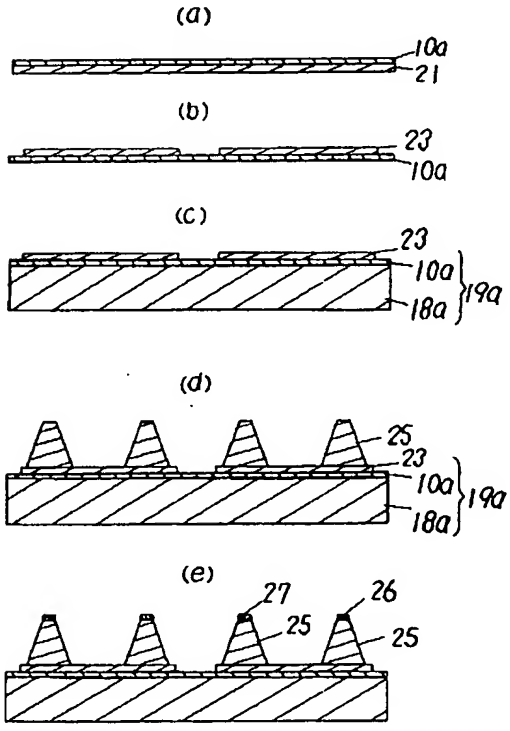
[Drawing 7]

19a/19b 絶縁板
23 電極膜
24 取り出し電極膜
25 電極部
26 P型熱電半導体膜
27 N型熱電半導体膜
28 対向電極膜



[Drawing 8]

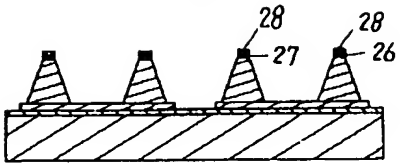
190 絶縁板
23 電極膜
25 電極部
26 P型熱電半導体膜
27 N型熱電半導体膜



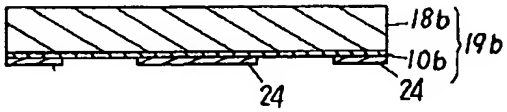
[Drawing 9]

19b　絶縁板
24　取り出し電極
28　対向電極膜

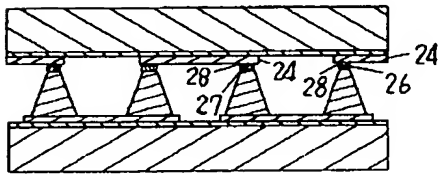
(a)



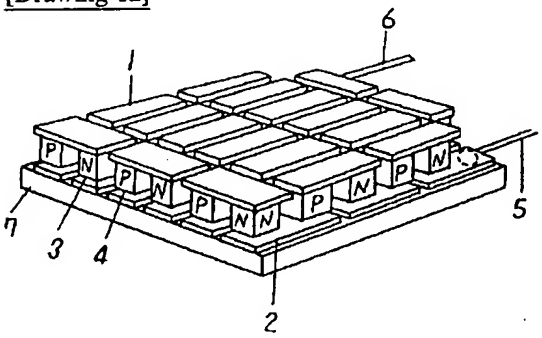
(b)



(c)



[Drawing 12]



[Translation done.]